MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. LV. MARCH 8, 1895. No. 5

Dr. A. A. COMMON, LL.D., F.R.S., President, in the Chair.

George Denton Hirst, Sydney, New South Wales, Australia ;
Samuel V. Hoffman, 1 Chelsea Square, New York City, U.S.A. ;
Henry T. C. Knox, F.R.G.S., Lieut. (late R.N.), 17 Upper Montague Street, W.;
E. F. J. Love, M.A., The University, Melbourne, Victoria, Australia ; and
The Rev. Daniel Higham Sparling, B.A., Rector of Biddulph Moor, Congleton,

were balloted for and duly elected Fellows of the Society.

The following candidates were proposed for election as Fellows of the Society, the names of the proposers from personal knowledge being appended :

Andrew Russell Forsyth, LL.D., F.R.S., Sadlerian Professor of Pure Mathematics, Cambridge (proposed by H. H. Turner) ;
John Willoughby Meares, Electrical Engineer, Clive Hall, Shrewsbury (proposed by Arthur Mee) ; and
William Willett, Junr., The Cedars, Chiselhurst Common, Kent, and 2 Sloane Gardens, S.W. (proposed by W. H. Thornthwaite).

One hundred and two presents were announced as having been received since the last meeting, including, amongst others :—

The Elements of the four inner planets and the fundamental Constants of Astronomy, by Simon Newcomb, presented by the

American Nautical Almanac Office ; Annals of Harvard College Observatory, vol. xxxii., Part I. (Investigations in Astronomical Photography, by W. H. Pickering), presented by the Observatory ; a sixteenth century celestial globe, on bronze tripod stand, presented by the Earl of Crawford ; three large transparencies of portions of the Moon, from negatives made with the equatorial coudé of the Paris Observatory, presented by MM. Lœwy and Puiseux.

On the Rotation and Mechanical State of the Sun.
By R. A. Sampson, M.A.

(*Abstract.*) *

The author's aim is to consider with the simplest sufficient hypotheses the mathematical theory of the mechanical state and the relative motions of the parts of the Sun.

Starting from the equations of equilibrium of a gas, it appears that equilibrium is a state which will only exist either (1) when the temperature is maintained a function of the density, or (2) when all quantities are geometrically functions of only one parameter.

In the former case it is shown under what condition a body of gas will cohere in finite volume, and that if this condition is unfulfilled the density can nowhere be finite unless the total mass be infinite.

The study of the second case begins with the law of distribution of temperature. Conduction is assumed to be inoperative until instability producing convection currents is proved to exist, so that the agent of distribution must be taken to be radiation. The author shows that if three hypotheses be made –

(1) Each isolated small body of gas radiates heat at a rate proportional to its mass and to its absolute temperature conjointly.

(2) Each small body of gas absorbs heat proportionally to its mass, and to the quantity of heat that penetrates it, conjointly.

(3) The entire radiations from any element of a sheet of matter pursue the same course (normal to the wave fronts) without interference ; then the temperature (θ) satisfies a partial differential equation, which yields the set of solutions—

$$\theta_n = \alpha_n \exp\left(-\frac{2\varpi\mu^2_n}{\mu^2_n + \varpi'^2}\,\frac{t}{c}\right)\cos \mu_n m,$$

where μ_n is one of the roots of

$$\mu \tan \mu \mathrm{M} = \varpi',$$

α is arbitrary, c, ϖ, ϖ' are certain constants, M is the total mass, and m is the mass within a certain surface passing through the

* For the complete paper, vide *Memoirs*, vol. li.

point considered. This applies to all arrangements in which the quantities are functions of but one parameter. Hence the temperature of a body cooling under radiation may be analysed into a number of elements, each of which cools at a definite rate; ultimately all others will disappear relatively to that of slowest rate.

Considering the equilibrium of a spherical body of gas under this law of temperature, it is shown that when the body is very great, the distribution of mass, density, and temperature is the following :—

r/a.	m/M	ρ/ρ_0.	θ/θ_0.
·0	·000	1·000	1·000
·1	·001	1·000	1·000
·2	·005	1·000	1·000
·3	·017	1·000	1·000
·4	·051	1·002	·997
·5	·079	1·008	·992
·6	·138	1·024	·977
·7	·223	1·064	·939
·8	·343	1·164	·858
·9	·520	1·461	·685
1·0	1·000	∞	0

Since the density increases outwards the distribution may be proved to be unstable, but the margin of instability being generally very small, the disturbances thence produced are not enough to change substantially the above distribution, except in the neighbourhood of the surface, where, if necessary, it may be supposed to give place to that of convective equilibrium.

If this theory be taken to apply to the Sun, we have a body affected throughout by convective currents, but substantially at uniform density and temperature, except near the surface, where this arrangement gives place to a rapid fall of temperature and density, accompanied by violent disturbance. This region of superficial violent disturbance appears as the main radiator, and it is shown numerically that this is a reasonable supposition. The main body, which is subject to less violent disturbances, radiates at a much lower rate, thence producing an effect of relative darkness.

Considering the rotation of the Sun, it appears that the data are not adequate to prove more than merely the sufficiency of an assigned cause. Starting from the equations of motion of a viscous gas, it is shown that Dunér's observations of daily angular rotation for 60° N. and S. lat. are consistent with the supposition of a velocity increasing inwards, and expressed by the formula

$$\omega = \omega_0 + r^{n-2}(\Omega - \omega_0),$$

where Ω is the observed surface rotation at any latitude, ω_0 is a constant derived from the calculations, and n is nearly equal to $2\frac{1}{4}$; taking $n=2\frac{1}{4}$, ω_0 is about one half the equatorial value of Ω. The data being indeterminative, the observations are also consistent with the above expression supplemented by an infinite arbitrary series ; but it is shown that to attach a finite value to any term of this series implies that a finite part of the angular motion increases inwards at least as fast as r^{-2}, that is to say at much greater rate than the motion at the surface decreases towards the poles.

Finally it is shown that if the atmosphere follow the law of convective equilibrium, the associated surface motion in latitude is a slight drift towards the poles.

The Wilsonian Theory and the Stonyhurst Drawings of Sun Spots.
By the Rev. Walter Sidgreaves, S.J.

The question of the cavernous nature of a Sun spot has been recently brought prominently before the attention of Solar Physicists by the Rev. Mr. Howlett in a paper read at the last December meeting of the Royal Astronomical Society. His handsome present to the library of the Society is in evidence of the care and labour devoted to the subject, and the long series of large-size drawings contained in those eight volumes, covering a period of thirty-five years, seem to place his verdict against the Wilsonian theory beyond the reach of contradiction, and to show that it stands in no need of a confirming witness.

The Stonyhurst drawings extend over considerably less than half the years of Mr. Howlett's work, and are made to a scale, in diameter, only the one-third of his. They are therefore of much less weight, both in number and size. They were not commenced nor carried on with the direct object of testing the Wilsonian theory ; but this was never lost sight of, and occasionally, when a spot was near the limb, a special drawing was made of it from an enlarged image, after the usual full surface drawing of $10\frac{1}{2}$ inches diameter was complete. The smaller drawing of the spot on such occasions was never retouched after its examination under the greater magnification ; and the uniform agreement between the pairs confirms the rule that whatever is seen satisfactorily with less magnification is never contradicted by an enlarged image.

To form a safe estimate of the value of the smaller drawings for the subject of discussion, it should be remembered that in all cases the outlines of the umbra and penumbra were traced with a finely-pointed pencil over the image upon the paper, and that no drawing was considered complete until the draughtsman was satisfied that his picture faithfully represented what he saw. Hand-drawings made in this way have a value hardly inferior to

that of a photograph, and may be even more trustworthy when not more than one photograph has been obtained.

For the selection of suitable spots over 2000 drawings have been examined dating from 1881 to 1894, and only those which were found to satisfy recognised conditions of suitability have received a mark for or against the Wilsonian theory. These conditions are :—(1) That the spot had been observed at a position approximately between 30″ and 60″ of arc from either limb ; (2) that it had been watched on its passage between the central meridian and the limb ; (3) that it was a compact regular spot ; (4) that it showed a central umbra when remote from the limb ; and (5) that it was a quiet spot, not indicating a tendency to divide or to change shape. We have 146 spots fulfilling these conditions. Of these 41 were double observations, the spots having been followed from limb to limb and observed near each. We have therefore 187 single tests, and of these 140 stand against, and 47 in favour of Wilson's doctrine, making a statement of 3 : 1 against it. But the individual cases are not of equal value, and when weighted on an estimate of 4 to 1 between the best and poorest of the selected spots the proportion rises to 3·66 : 1 against Wilson. This, so far, is a much weaker opposition than is established by Mr. Howlett's more valuable collection of drawings. But if we estimate the worth of the 47 cases quoted for Wilson on the lines of his own valuation of their testimony, nearly all the 47 witnesses will go out of court. Dr. Wilson, in "An answer to the objections stated by M. de la Lande,"* that the Wilsonian foreshortening was not always seen, points out that a shallow spot must be much nearer the limb than a deep and steep one to exhibit the same inequality of the two sides of the penumbra. and that a very shallow spot would go off the limb without showing any perceptible difference of this nature. To make this clear he gives computed angular distances, from the limb, of four cavernous depths, at which the more foreshortened side would contract to a line, and appends the corresponding apparent widths of the opposite side. His figures for spots of the first and second classes, in the order of decreasing depths, are :—at 60″ from the limb, the inward side of penumbra vanishing and outer side width 8″·58 ; at 30″ distance, inward side vanishing, outer side width 6″ 02.† Now of our 47 cases favourable to Wilson the best is perhaps the one near the eastern limb on 1886 May 21. It is a good spot with a good history, and judging by its size and darkness it should be ranked at least in Wilson's second class. It should therefore, when at 30″ from the limb, have lost the inward side of its penumbra : it was just within 30″ distance, and showed the

* *Phil. Trans.*, anno 1783, vol. lxxiii.

† The great spot of November 1769, which first drew Dr. Wilson's attention to the subject, was estimated, from his observations at the return of the spot in December, to have been at this limiting position, at 90″ from the eastern limb.

inward side a little more than half the width of the outer side. It may well be doubted whether Dr. Wilson would have formulated his cavernous theory upon these cases, which would indicate declivities too small to be worthy of notice. There is, however, one case which has no exception to its evidence, and which but for the smallness of the spot would take precedence of the one just mentioned. It crossed the Sun's disc in the last half of July 1884. It appears on the drawings at 35″ from the eastern limb on the 17th, and at 2′ on the 18th, quite clearly for Wilson. On the 19th the umbra was central at 3′ 30″ distance. On the 20th the umbra was broken on the eastern side ; but it had recovered on the 23rd, and remained quiet and central on the 24th and 25th. Finally, on the 28th, again at 35″ from the limb, it was the reversed picture of its first appearance. The diameter of the spot when near the middle of the disc on the 23rd was 20″, and it might be placed in Wilson's third class, which would not lose its inward penumbra at a distance greater than 15″.

In the course of looking through the drawings, for the purpose of this discussion, the necessity of care in selection has become very apparent. Many of the spots having full records of their behaviour in transit across the Sun's disc have been found untrustworthy witnesses, owing to the inconstant form of the umbra : the umbra may be spreading to one side, growing, or decaying, and the whole spot may be going through the process of division. A remarkable example of this kind of change is offered, as a warning, by a spot at about 20″ from the eastern limb on 1885 July 17. Its appearance then was very strongly in favour of Wilson's theory, and when near the central meridian on July 21 and 24 the umbra was quite sufficiently central to give any desired confirmation of the foreshortening effect at the limb. But on July 20, when the spot was at full 5′ from the limb, out of the reach of foreshortening, the penumbra was still dilated on the eastern side, and, comparing the drawings of the 21st and 20th, it was manifest that the umbra had extended eastwards to fill up the central void in the penumbra. If, therefore, this page of its history had been lost, the spot would have had great weight for the Wilsonian theory.

A similar example is the leading member of the twin spot on the drawings between 1888 May 11 and 23. This spot also went well for Wilson on the 12th, but failed afterwards. A new nucleus appeared on the 14th in the wider part of the penumbra, and the spot divided into a pair before arriving at the western limb.

Amongst the number of spots which tell against this supposed cavernous form there are not a few which go further and indicate rather a mountainous umbra, on the supposition of foreshortened effect upon the penumbra. The large round spot of 1887 June, selected by the late Father Perry to illustrate his paper in the *Memoirs* of the R.A.S. vol. xlix., is an instance of this. It was drawn on the 5th, when its centre was only 7″ of

arc from the eastern limb, and the picture shows no penumbra on the off side, or limb side, while it is well in sight on the inward side, as if a dark elevation were screening the further side of the penumbra from view. The spot was regular, and there was nothing in its history to favour the supposition that its eastern side was wanting in penumbra at the time. Another example merits attention on account of an enlarged drawing made of it, after the usual chart of the Sun's surface was finished. On both the smaller and larger pictures only a thin trace of the penumbra is seen on the limb side, while it is well in sight on the opposite side, the spot being only 7″ from the limb. These drawings were made on 1889 July 12, and show the beginning of the second rotation of the great spot of the year which lived from June 16 to August 20.

A strong confirmation of Mr. Howlett's conclusion is offered by a large number of the Stonyhurst drawings which show spots very near to either of the solar limbs. The argument is suggested by Wilson's reply to De la Lande already mentioned. He there extends his computations to fixing the narrower limits within which the nucleus must be "hid" by the "lip of the excavation." These limits for his four cases of decreasing depths are 16″·9, 8″·9, 4″·7, and 2″·7. We have probably between 400 and 500 drawings of spots of every size and intensity within 10″ of either limb. Of these about one third would probably have to be rejected as too small to give any certain evidence ; and all the rest, if we may trust the memory of the observers, would show Wilson's nucleus, or, as it is now called, the umbra, quite distinctly. It has not been thought necessary to re-examine the whole series of drawings for this argument, but as a test of the accuracy of memory those of the years 1884 and 1889, periods respectively of maximum and minimum frequency, were selected, and these provided, together, 64 spots within the 10″ limit : 24 of these were useless, and the remaining 40, at distances from the limb from 2″ to 10″, showed the umbra well marked and quite distinct from the penumbra. It is therefore safe to conclude that the umbra is not often shut out of sight by the "lip of the excavation."

The notches, seen occasionally in the Sun's limb when a spot has been rounding it, are extreme evidences of this nature ; and Wilson evidently felt the force of De la Lande's attack, founded upon these dark indentations reported by De la Hire in 1703 and by Cassini in 1719. His answer is founded upon the belief that these were at least very small—so small that his shallowest spots might show the nucleus when at zero-distance from the limb. He would have found it impossible to answer the Dehra Dun photograph of 1884 September 17.* This admits of no other explanation than that of a high elevation of the umbra. He

* A very faithful reproduction of this photograph is given in *Nature*, vol. xxxiii. p. 469.

might have rejected its evidence as proving too much ; and it must be admitted that if the photographic copy in our possession truly represents the border of the solar surface at the position of the spot, the phenomenon represented is of the rarest nature. We have nothing like it from the many observers of more recent times, including the hundreds of spots which must have been observed by Mr. Howlett very near to the limb. If such a piling up of opaque matter were not rare in the extreme, it would have manifested itself by an East-to-West widening of the umbra at some of these many observed positions near the limb. There is no such widening shown on the drawings of this spot when it was approaching the western limb; the umbra had diminished in apparent East-to-West width by one half between the 15th and 16th of September, and should have contracted to a mere line on the 17th. The Stonyhurst drawing on the 17th was made at four o'clock in the afternoon, probably about ten hours after the Indian photograph, and may have been too late to catch the umbra on the limb ; only the penumbra is shown on the sketch. The Greenwich photograph was taken at $10^h\ 20^m$ A.M. of the same civil day—about four hours after the Indian photograph, and only the penumbra is quoted in the Greenwich volume as visible on the photograph. On the other hand, there is nothing on the Indian plate to indicate photographic treachery : the notching umbra is perfectly natural, of a strong silver deposit, and showing a woolly outline in every way like that of its neighbouring spot ; and although we have nothing to compare with it in our collection of drawings, there are imitations of it on a microscopical scale in the form of a little notch in the outer penumbra in spots near, but not on, the limb. These have been also observed by Mr. W. Hale White, who describes them in the *Journal* of the British Astronomical Association, vol. v., No. 4, as "constantly noticed. When a spot was close to the edge, the umbra rose in front of the outer penumbra like a projecting rock against the sky." It is impossible, therefore, to reject altogether the evidence of the Indian photograph, and it goes straight for a mountainous rather than a cavernous form. Mr. Howlett has already stated the inadmissible postulates required for a physically hollow notch : it would mean a deep furrow lying East-to-West, of so great a length that it could not have failed to manifest itself on the previous day.

Mr. Howlett has expressed a conviction that the penumbra of a spot "presents a convex surface—a curve conformable to the general contour of the solar orb" ; and, presumably, he includes the umbra in the curved surface. Our own observations at Stonyhurst, while confirming this statement as that of the usual form of a spot, lead to the admission of not unfrequent exceptions. It has been noted that some of the selected spots, which have been followed from limb to limb, score oppositely : at one limb for the Wilsonian doctrine, at another against it ; and, again, that, in several of the cases quoted against

Wilson, their opposition to his theory is more than contradictory of it : it is contrary to it, showing the wrong side of the penumbra contracted. Both these notes indicate elevation of the umbra rather than depression. It is a simple supposition, for bringing all the observations into accord, that the umbra, generally, is on a level with the penumbra, but sometimes above it, sometimes below. And it will probably be granted that this variation is more in keeping with the modern belief in some form of cloud-like opacity for the cause of the central darkness of a spot. The warmest supporter of the Wilsonion theory will hardly accept the physical part of it, that the darkness is the floor of a cavern opening to an opaque central mass ; and without this prepossession on the part of Dr. Wilson it is not easy to see why he should have been at such pains to maintain that even shallow spots are but rare exceptions to a rule.

1895 *March* 3.

An Apparatus for Mechanically Calculating Star Corrections.

By W. E. Cooke.

(*Communicated by Professor H. H. Turner.*)

This machine, the principal part of which is shown in plan in the accompanying diagram (see plate 5), is mounted on a deal table with a cover, the top of which can be used as a drawing-board.

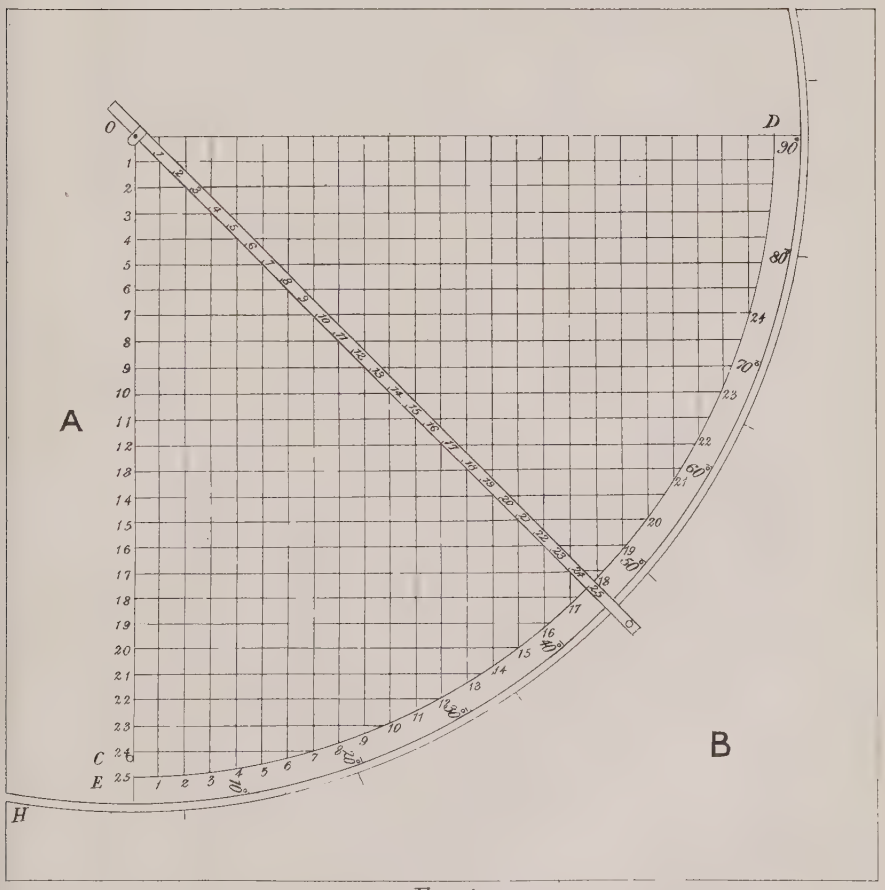
It consists essentially of a square sheet of zinc, divided into two portions, A and B, by means of a circular cut. B is fixed securely to the table top, and A is pivoted at O, a substantial spindle ($\frac{3}{8}$ inch thick) being screwed to the table, passing through a metal sheath in A, and projecting slightly above it. A flat metal straightedge, or ruler, 28 inches long, having a small metal projection near one end, through which a $\frac{3}{8}$-inch circular hole is drilled, with its centre exactly in line with the edge of the ruler, is pivoted on that portion of the spindle which projects above A. On the under side of A, at the point marked C, clamping and tangent screws are fixed, passing through a slotted aperture of 20° in the table top.

Thus both A and the ruler can be turned, independently of each other, on the spindle O, and A can be clamped in any desired position.

On A the quadrant ODE is drawn. Each line or radius OD and OE is divided into tenths of an inch, and perpendiculars drawn through each point, thus reticulating the quadrant into 0·1 inch squares. Every tenth division is marked by a thick black line, corresponding to each second of arc. (These only are shown in the accompanying diagram figured 0 to 25, commencing from the centre 0.) The half seconds, or every alternate fifth division, are drawn in red, and a thin black line marks the intermediate divisions, or tenths of seconds. The ruler, pivoted at 0, is similarly divided 0–25.

The edge of the quadrant is divided into degrees, and every tenth minute of arc, starting at E, and every minute can be easily estimated. The rim of B is graduated into hours and minutes, starting at H and extending for 7^h. The minutes are figured, but the hours are *not*.

For any given night's work we have a set of stars extending over 2 or 3 hours in R.A. Take any one of these hours, multiply by 15 to reduce to degrees, and add to G (from the *Nautical Almanac*). This gives $(G+\alpha)$ corresponding to some whole hour of α. Let us take a simple case first. Suppose this value of $(G+\alpha)$ is less than 90°. Turn A on its pivot until $(G+\alpha)$ on the rim of A corresponds with some (unfigured) whole hour on the rim of B and then clamp. Then with a pencil figure this par-



Front

LEEDS PHILOSOPHICAL AND LITERARY

ticular hour according to the above value of a. [As a matter of practice it is unnecessary to clamp, or to actually write in this value of a, for the stars to be reduced generally run straight forward in R.A.]

To obtain $g \sin (G+a)$ and $g \cos (G+a)$ for any value of a, move the ruler until its edge corresponds with the given value of a as read on B. The $\angle$ EOa will then be $(G+a)$, and the value of g on the ruler's edge will give $g \sin (G+a)$ and $g \cos (G+a)$ as read off on the reticulated quadrant. When these quantities have been obtained for each star, take out similarly the values of $h \sin (H+a)$ and $h \cos (H+a)$. Then set the ruler to the dec. of any star, and without moving it read off $[g \sin (G+a)] \sin \delta$, $i \cos \delta$, and $[h \cos (H+a)] \sin \delta$. Also, if it come within the limits of the machine, multiply the sum of $g \sin (G+a) \sin \delta$ and $h \sin (H+a)$ by sec. δ. This is done by reversing the above operation—*i.e.* take the value of this sum along OE and find where the corresponding perpendicular cuts the ruler. Of course, if either this sum, or the value of δ be large, the machine will not be able to multiply by the sec. δ.

We took just now the simple case where $(G+a)$ or $(H+a)$ is less than 90°. If it be $> 90°$, subtract either 90°, 180°, or 270°, as required, reading sin. for cos. where necessary, and prefixing the appropriate sign.

If, after setting A for some definite value of $(G+a)$ and running the ruler round the quadrant for successive stars, we reach D, we must bring the ruler back again to E, and read cos. for sin., and *vice versa*.

As to a practical test of accuracy and speed, we have only just completed the instrument at the Adelaide Observatory, and are not in a position to make a definite statement. But ten stars were taken, extending over about $1\frac{1}{2}^h$ R.A., and between $-12°$ and $+12°$ decl. These were reduced first by the machine, and secondly by Stone's tables. The greatest discordances were $0^s{\cdot}002$ in R.A., and $0''{\cdot}03$ in δ, and the machine reductions occupied only about half the time of the tabular.

I do not think the machine could be recommended for reducing in R.A. stars of high δ, unless the same error in arc be allowed for circumpolars as for stars near the equator, for the sum of two quantities $[h \sin (H+a)$ and $g \sin (G+a) \sin \delta]$ has to be multiplied by the sec. δ. It ought to reduce any star in NPD, no matter what its δ might be.

But I think the above difficulty might be overcome with a little tabulating and a modification of the reduction formulæ. Let us suppose two stars of the same R.A., but differing in δ. Call the decs. δ_1 and δ_2. Then the *difference* between the reductions in R.A. for those stars on the same date is

$$g \sin (G+a) (\tan \delta_1 - \tan \delta_2) + h \sin (H+a) (\sec \delta_1 - \sec \delta_2).$$

Suppose now that reductions were calculated for every tenth day for decs. 20°, 40°, and 60°, and tabulated for each hour of R.A. The reduction in R.A. for a star of, say, 68° δ would be effected as follows :—

First obtain reduction of a star of same R.A. and 60° δ by interpolation from tables. Then, with the machine, extract $g \sin (G+\alpha)$ and multiply this by (tan 68° − tan 60°)=0·743 = natural sine of 47° 59′. Similarly $h \sin (H+\alpha)$ (sec 68°-sec 60°) would be obtained, and the sum of these two quantities added to the reduction for 60° (obtained from the tables).

If this method be adopted, it will be advisable to figure the natural sines round the rim of A, and the only quantities required from the logarithm tables will be the tan δ and sec δ of each star.

Note on Mr. Cooke's Paper. By Professor H. H. Turner, M.A., B.Sc.

Just a year ago Mr. Cooke drew attention * to a method of simplifying the calculation of star-corrections in N.P.D., and I followed his paper by an account of some mechanical methods which I had been considering. An apparatus has since been constructed on the plan described in *Monthly Notices* liv. p. 367 by Messrs. Troughton and Simms, and used with success at the Royal Observatory, Greenwich.

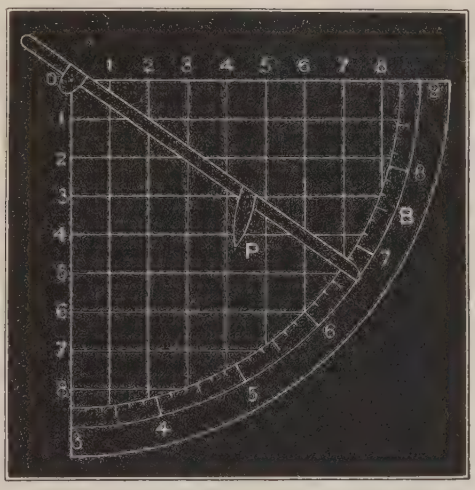
Mr. Cooke's present paper, which I received from Sir Charles Todd a few days ago, suggests one or two improvements in this plan, the importance of which I am glad to be the first to recognise. His use of the cross reticule instead of an extra sliding piece is an obvious convenience. But much more important is his remark that it is not necessary to figure the hours, but the minutes only. This reduces the necessary size of the machine to one quarter ; or, in other words, makes it possible to have a scale twice as large as before.

I may perhaps add, in my turn, to his suggestions as follows : -

(1) It is now not necessary to have two pivoted parts of the machine, as he suggests. The arc B may be clamped to the table if only we have a pointer P which may be attached to the revolving ruler in an arbitrary manner. Thus, suppose we wish to find $g \cos (G + \alpha)$, and that $G = 22^h\ 32^m$. Set the ruler to $0^h\ 28^m$, and make the point P fall on the zero line at the distance g. Then figure the hours 3, 4, &c., instead of 0^h, 1^h, &c. Hence

* *Monthly Notices* vol. liv. p. 358.

when the ruler reads $3^h\ 28^m$ on B, we get the pointer giving us g and o, which are the cosine and sine required.



(2) If any difficulty is found in having the zinc and paper reticule accurate enough, a glass reticule might be used, such as those employed for the Astrographic Chart. I am proceeding with the consideration of details on these lines.

A Systematic Comparison between the Places of Stars given in the Cape Catalogue for 1880 *and the Radcliffe Catalogue for* 1890. By E. J. Stone, M.A., F.R.S., Radcliffe Observer.

My wish is that the Radcliffe Catalogue for 1890 should be regarded as a continuation and completion of the general survey of the southern sky, which I commenced at the Cape in 1870. The agreement or disagreement of the results of these Catalogues is therefore, from my point of view, one of primary importance.

In collecting the materials for the Cape Catalogue, 1880, the chief object in view was to fix the positions of well-distributed zero points from the South Pole, N.P.D. 180°, to less than N.P.D. 115°, with all the accuracy attainable within the limits of the probable error of the mean of at least three observations of each element. In the collection of the materials included in the Radcliffe Catalogue the same plan has been followed for the stars from N.P.D. 115° to the Equator. But it was my earnest wish to render the results *as independent as possible* ; and to trust to the agreement or disagreement of the results which overlap as a test of the accuracy attained. I, therefore, purposely made the Oxford observations well overlap those at the Cape to afford materials for this comparison ; and I need hardly say that I have looked forward to the result with some natural anxiety.

The comparison has now been systematically and regularly carried out. The number of observations compared has been very considerable ; and the work of comparison has involved much arithmetical labour ; but the results can be exhibited in the form of tables, without taking up any great amount of space.

I have also added a comparison between the Radcliffe results and those of the Greenwich Ten-year Catalogue for 1880. The systematic differences are nearly the same as those between the Radcliffe Catalogue, 1890, and the Greenwich Five-year Catalogue of 258 Fundamental Stars for 1890, given in the *Monthly Notices* for November, 1894 ; but the comparisons given in the present paper include a much greater number of stars.

The positions in the Radcliffe Catalogue, 1890, for stars of much greater N.P.D. than 115° are not, of course, of much value, either in R.A. or N.P.D., except for discussion of questions of refraction ; and similar remarks apply to those of the Cape Catalogue for N.P.D. much less than 45°.

An examination of the differences in R.A. and N.P.D. between the Radcliffe and Cape Catalogues shows the existence of small but systematic differences both in R.A. and N.P.D. I am not, at present, able to give any perfectly satisfactory explanation of the cause of the change of these differences in R.A. with the N.P.D., which are certainly rather larger than I expected, and which possibly may be chiefly due to the Oxford observations,

although the R.A.'s of the Melbourne Catalogue, 1880, certainly show a similar law of discordance from those of the Greenwich Catalogue, 1880 (see Dr. Downing's Table V. p 310, *Monthly Notices*, vol. li.). But these differences are at all events as small as those between the determinations of epoch corrections required by the different systems of fundamental stars at present employed; and the mean differences between the two Catalogues from the equator to N.P.D. 115° are so small that the results may be combined without leading to errors of any practical importance. The differences between the N.P.D. of the two Catalogues are so small that the application of a correction of + 0″·20 to the Radcliffe N.P.D. and − 0″·20 to the Cape N.P.D. would remove the discrepancy; and such errors are certainly within the limits of those which may arise from defects of the refraction tables in use.

The Greenwich observations differ more from the Radcliffe observations than those made at the Cape, and these differences agree with the results found from a comparison between the Greenwich, 1890, and the Radcliffe, 1890; but I have nothing, at present, to add on this point to my remarks in the *Monthly Notices* for November. With regard to the general accuracy of the Cape and Radcliffe results, I would appeal to the comparison between the Cape, 1880, and the Argentine General Catalogue for 1875 given by Dr. Downing in the *Monthly Notices* for June, 1887. As a matter of fact the N.P.D's of the Argentine Catalogue agree almost identically, in mean results, with the Radcliffe, 1890.

As a further check I give the comparisons between the results of the Cape Catalogue, 1885, lately published by Dr. Gill; but I have taken these results *directly from the General Catalogue, as found from the Cape work*, without applying certain corrections which Dr. Gill has shown would make his results agree rather more closely with those of the Greenwich Catalogues. This course is necessary if the agreement between the Cape and Greenwich results is to be appealed to as a proof of the accuracy of the positions of the stars given in these Catalogues.

The co-latitude of the Cape found by Dr. Gill from the circumpolar stars, and adopted in the formation of his Catalogue, is

$$123^\circ\ 56'\ 3''{\cdot}35;$$

whilst that adopted in the Cape Catalogue, 1880, is

$$123^\circ\ 56'\ 3''{\cdot}41;$$

and these results are, therefore, in close agreement.

The N.P.D.'s of the 1880 and 1885 Catalogues should therefore agree for stars at N.P.D. 124°. This is found to be the case; and the differences between the results should be confined within smaller limits than 0″·25 for all stars between N.P.D. 70°

and 124°, if they are unaffected by any other systematic errors than the effects on the refractions of a difference of 1°·6 F. due to an alteration of the thermometer exposures. But an examination of the differences of the division corrections applied 1870–1879 and 1880–1885, although small, will show that they are of the order of magnitude which is here under consideration. The results included in the Cape Catalogue, 1885, are also certainly not free from suspicion of systematic errors of sensible amount when the R – D discordance varies between +1″ and −1″ (see Table I. p. xvii. of the Cape, 1885, Catalogue); and although the R – D discordance was certainly confined within much smaller limits at the Cape, during the years 1874–1879, I am not prepared to assert that these observations may not have been affected by some small systematic errors due to the same causes which have affected the observations 1880–1885, and which I believe to be chiefly instrumental.

It should be mentioned that the fundamental epoch of the Cape Catalogue, 1880, is that of the Greenwich standard list; whilst Dr. Gill has adopted for the Cape Catalogue, 1885, the fundamental epoch of Dr. Auwers' "Fundamental-Catalog für die Zonen-Beobachtungen am nördlichen Himmel," and this is the chief cause of the small and nearly constant differences in R.A.

If the corrections, which Dr. Gill has deduced from a discussion of the Pulkowa and Greenwich observations, are applied to the results of the Cape Catalogue, 1885, the N.P.D.'s agree rather more closely with the Cape Catalogue, 1880, and less closely with the Radcliffe, 1890, than before; but the differences are in both cases *exceedingly small*, as will be seen on reference to the Tables given in this paper (see Tables I. and III.).

With regard to the non-application of any corrections for R – D discordance to the Radcliffe observations, the mean differences for R – D with the zenith-points found from the Nadir observations given in the results 1881–1887, after corrections for flexure have been, as they should be, applied, is for North stars −0″·235 with a weight 1518, and for South stars −0″·104 with a weight 2084, and these differences would only indicate an error in mean Nadir correction of

$$+0''\cdot080\ ;$$

a quantity, whose effects are included in the co-latitude investigation, and which I consider too small and uncertain in its determination to render it necessary, for practical purposes, to discuss whether it is due to error of flexure correction, outstanding errors of division, or causes affecting solely the reflexion observations connected with atmospheric conditions in the observing room; or rather to their combined effects. My experience does not give me much confidence in the freedom of absolute places from systematic errors much less than ±0″·25; and, although I have tried to keep the errors as small as possible,

I certainly do not claim that either the results of the Cape Catalogue, 1880, or the Radcliffe Catalogue for 1890 are free from possible systematic errors within such limits. But the agreement between the Cape, 1880, results and those of the Radcliffe, 1890, is an unforced one; the systematic discordances are certainly confined within narrow limits; and the results of the two Catalogues combined afford positions of stars well distributed over the whole Southern hemisphere, which are not, so far as I can test them, affected with any serious systematic errors.

TABLE I.

Mean Results of Comparisons between Radcliffe, 1890, Stone, 1880, and Greenwich, 1880.

Group.	Mean N.P.D. of Group, Stone.	Differences in R.A. × sin N.P.D.				Differences in N.P.D.			
		Radcliffe minus Stone.	Wt.	Radcliffe minus Greenwich.	Wt.	Radcliffe minus Stone.	Wt.	Radcliffe minus Greenwich.	Wt.
°	° ′	s		s		″		″	
0–5	...	...	...	+0·014	636	...	...	−0·13	706
5–10	...	...	...	+0·024	17	...	...	+0·08	36
10–15	...	...	...	−0·017	54	...	...	+0·11	88
15 20	...	...	...	−0·014	71	...	...	−0·23	157
20–25	...	...	...	−0·017	64	...	...	−0·40	160
25 30	...	...	...	−0 002	62	...	...	−0·68	194
30–38½	...	...	...	−0·005	55	...	...	−0·57	64
38¼–45	42 0	+0·015	4	+0·001	67	−0·72	10	−0·64	69
45–50	46 0	+0·050	5	+0·027	44	−0·27	7	−0 29	8
50–55	52 0	+0·045	11	+0·014	74	−0·83	13	−0·55	106
55–60	57 30	+0·042	22	+0·031	69	−0·10	6	−0·51	87
60–65	62 0	+0 056	118	+0 040	229	−0·33	24	−0·88	205
65–70	68 0	+0 041	130	+0·036	296	−0·60	36	−0·86	222
70–75	72 30	+0·057	151	+0·043	346	−0·39	29	−0·78	251
75–80	77 30	+0·037	233	+0·038	405	−0·48	45	−1·17	213
80–85	82 30	+0·034	293	+0·034	482	−0·36	69	−1·10	196
85–90	87 30	+0·036	181	+0·028	352	−0·53	48	−0·73	169
90–95	92 30	+0·017	397	+0 014	600	−0·49	193	−0·68	427
95–100	97 30	−0·004	352	−0·017	617	−0·63	179	−0·91	438
100–105	102 30	−0·021	259	−0·040	495	−0·38	174	−0·84	393
105–110	107 30	−0·024	277	−0·051	606	−0·47	123	−0·93	484
110–115	112 30	−0·053	642	−0·078	368	−0·36	550	−0·98	327
115–120	117 30	−0·064	303	−0 091	195	−0·04	254	−0·96	160
120–125½	122 30	−0·133	145	−0·158	45	+0 84	155	−0·79	47

TABLE

Differences between the Radcliffe Catalogue, 1890; *the Cape Catalogue,*

Differences of

N.P.D. of Group.	0h to 6h. Radcliffe minus Cape, 1880.	Weight.	0h to 6h. Radcliffe minus Greenwich, 1880.	Weight.	6h to 12h. Radcliffe minus Cape, 1880.	Weight.	6h to 12h. Radcliffe minus Greenwich, 1880.	Weight.	12h to Radcliffe minus Cape, 1880.	Weight.
	s		s		s		s		s	
45° to 50°	+0·036	1	+0·024	19	...	...	+0·006	8	...	...
50 „ 55	−0·063	1	+0·025	32	...	...	...	...	+0·135	1
55 „ 60	+0·025	3	+0·047	9	−0·025	5	+0·010	20	+0·061	10
60 „ 65	+0·034	20	+0·029	44	+0·050	31	+0·064	44	+0·057	46
65 „ 70	+0·067	37	+0·042	118	+0·028	87	+0·032	138	...	...
70 „ 75	+0·042	44	+0·043	103	+0·052	58	+0·039	107	+0·076	47
75 „ 80	+0·035	30	+0·047	70	+0·030	78	+0·039	124	+0·032	39
80 „ 85	+0·023	75	+0·022	155	+0·029	94	+0·029	148	+0·050	33
85 „ 90	+0·035	53	+0·025	84	+0·024	31	+0·028	79	+0·032	49
90 „ 95	+0·005	136	+0·019	158	−0·003	76	+0·007	65	+0·035	101
95 „ 100	−0·005	161	−0·010	197	−0·008	78	−0·019	73	−0·018	40
100 „ 105	−0·036	73	−0·061	89	−0·025	63	−0·036	95	−0·002	48
105 „ 110	−0·010	63	−0·053	82	−0·035	70	−0·053	98	−0·028	81
110 „ 115	−0·055	173	−0·076	74	−0·066	132	−0·075	78	−0·057	185
115 „ 120	−0·004	40	−0·012	6	−0·104	76	−0·114	38	−0·082	94
Means 45 „ 120	−0·003		+0·005		−0·010		+0·003		−0·009	
„ 90 „ 115	−0·021		−0·024		−0·031		−0·038		−0·022	

Differences

45° to 50°	+1″·03	4	+0″·04	25	″ ...	...	−0″·72	8	″ ...	...
50 „ 55	+1·09	2	−0·32	19	...	...	...	...	−1·03	7
55 „ 60	−0·03	2	−0·11	10	+0·05	2	−0·76	26	+0·27	1
60 „ 65	−0·47	6	−0·71	43	−0·02	8	−0·92	27	−0·87	5
65 „ 70	−0·50	14	−0·82	84	−0·81	19	−0·88	111	...	...
70 „ 75	−0·39	10	−0·85	66	−0·45	9	−0·97	61	−0·34	9
75 „ 80	−0·12	10	−0·96	40	−0·46	15	−1·27	76	−0·57	6
80 „ 85	−0·38	26	−0·95	62	−0·13	16	−1·04	68	−0·68	5
85 „ 90	−0·38	10	−0·58	31	−0·47	12	−0·75	49	−0·55	11
90 „ 95	−0·46	87	−0·66	116	−0·50	54	−0·54	59	−0·66	22
95 „ 100	−0·52	83	−0·85	119	−0·77	50	−0·71	64	−0·97	15
100 „ 105	−0·17	51	−0·74	79	−0·41	49	−0·90	82	−0·82	14
105 „ 110	−0·13	25	−0·88	61	−0·63	43	−0·65	86	−0·75	24
110 „ 115	−0·45	163	−1·10	68	−0·36	111	−0·91	65	−0·23	133
115 „ 120	−0·06	40	−1·45	6	+0·16	68	−0·57	39	−0·36	84
Means 45 „ 120	−0·35		−0·78		−0·39		−0·85		−0·44	
„ 90 „ 115	−0·41		−0·82		−0·49		−0·75		−0·43	

II.

1880; *and the Greenwich,* 1880; *for Six-hour Groups.*

R.A. sin N.P.D.

18^h.		18^h to 24^h.				0^h to 24^h.				
Radcliffe minus Greenwich, 1880.	Weight.	Radcliffe minus Cape, 1880.	Weight.	Radcliffe minus Greenwich 1880.	Weight.	Radcliffe minus Cape, 1880.	Weight.	Radcliffe minus Greenwich, 1880.	Weight.	Mean N.P.D. in Cape, 1880.
s		s		s		s		s		° ′
+0·065	2	+0·054	4	+0·036	15	+0·050	5	+0·027	44	46 0
+0·005	19	+0·048	9	+0·009	23	+0·045	11	+0·014	74	52·0
+0·046	30	+0·093	4	+0·013	10	+0·042	22	+0·031	69	57·30
+0·035	96	+0·081	21	+0·037	45	+0·056	118	+0·040	229	62·0
+0·002	5	+0·067	6	+0·035	35	+0·041	130	+0·036	296	68·0
+0·045	123	+0·086	2	+0·052	13	+0·057	151	+0·043	346	72·30
+0·034	73	+0·047	86	+0·035	138	+0·037	233	+0·038	405	77·30
+0·064	38	+0·042	91	+0·045	141	+0·034	293	+0·034	482	82·30
+0·036	110	+0·046	48	+0·021	79	+0·036	181	+0·028	352	87·30
+0·013	179	+0·034	84	+0·013	198	+0·017	397	+0·014	600	92·30
−0·023	132	+0·008	73	−0·018	215	−0·004	352	−0·017	617	97·30
−0·033	144	−0·017	75	−0·037	167	−0·021	259	−0·040	495	102·30
−0·053	197	−0·019	63	−0·046	229	−0·024	277	−0·051	606	107·30
−0·086	130	−0·034	152	−0·071	86	−0·053	642	−0·078	368	112·30
−0·099	62	−0·038	93	−0·082	89	−0·064	303	−0·091	195	117·30
−0·006		+0·007		−0·010		−0·004		−0·002		
−0·035		−0·010		−0·027		−0·021		−0·030		

in N.P.D.

−1″·15	3	−1″·99	3	−0″·39	22	−0″·27	7	−0″·29	58	46 0
−0·79	39	−1·43	4	−0·43	48	−0·83	13	−0·55	106	52·0
−0·47	35	−0·92	1	−0·46	16	−0·10	6	−0·51	87	57·30
−1·03	83	−0·12	5	−0·77	52	−0·33	24	−0·88	205	62·0
−0·60	6	+0·27	3	−1·03	21	−0·60	36	−0·86	222	68·0
−0·67	117	−0·36	1	−0·27	7	−0·39	29	−0·78	251	72·30
−1·07	38	−0·72	14	−1·27	59	−0·48	45	−1·17	213	77·30
−1·64	17	−0·42	22	−1·19	49	−0·36	69	−1·10	196	82·30
−0·74	47	−0·64	15	−0·81	42	−0·53	48	−0·73	169	87·30
−0·70	137	−0·45	30	−0·76	115	−0·49	193	−0·68	427	92·30
−0·87	112	−0·55	31	−1·09	143	−0·63	179	−0·91	438	97·30
−0·79	95	−0·42	60	−0·90	137	−0·38	174	−0·84	393	102·30
−0·91	168	−0·31	31	−1·10	169	−0·47	123	−0·93	484	107·30
−0·85	113	−0·39	143	−1·11	81	−0·36	550	−0·98	327	112·30
−1·13	61	+0·20	62	−1·01	54	−0·04	254	−0·96	160	117·30
−0·85		−0·35		−0·95		−0·38		−0·86		
−0·83		−0·41		−1·00		−0·44		−0·87		

TABLE III.

Comparisons between the Cape Catalogues, 1880 (*Stone*), *and* 1885 (*Gill*).

Group. N.P.D.	Stone minus Gill in R.A. $\delta\alpha \cdot \sin\Delta$.	Weight.	Stone minus Gill in N.P.D. $\delta\Delta$.	Weight.
°	s		″	
70–75	−0·031	87	−0·13	23
75–80	−0·024	183	−0·08	47
80–85	−0·025	313	+0·04	94
85–90	−0·036	186	+0·23	56
90–95	−0·032	330	+0·29	142
95–100	−0·033	311	+0·27	136
100–105	−0·024	176	+0·28	111
105–110	−0·014	218	+0·35	104
110–115	−0·041	210	+0·29	123
115–120	−0·035	178	0·03	132

On the mean places of Eight Southern Close Polar Stars.

By E. J. Stone, M.A., F.R.S., Radcliffe Observer.

In 1874 February I published and circulated the mean places of eight Southern close Polar Stars for the years 1860–1900. These places were deduced almost exclusively from observations made at the Cape Observatory, 1829–1873. The observations were brought up from one epoch to another, accurately by the trigonometrical method, with Peters' value of the precession constant; and the proper motions given are merely the small outstanding corrections found from a discussion of the residual errors, on the assumption that the places required corrections of the form

$$\text{constant} + \text{constant}\ (t - 1860).$$

The publication of a Cape Catalogue of 1,713 stars by Dr. Gill has led me to compare the computed places with the following Catalogues :—Cape, 1860; Melbourne, 1870; Cape, 1880; Cape, 1885; and the Appendix to the Cape, 1885, which gives the results of the circumpolar observations, 1881–1888 for the epoch 1885.

The agreement of the computed places with the catalogued places appears to me remarkable for such close circumpolar stars; in fact, the differences between the Right Ascensions given in the General Catalogue, 1885, and the Appendix are as great as the discordances between the computed and catalogued places themselves.

But my chief object in writing this Note has been to call attention to the smallness of the "proper motions in R.A." The fact that these residual motions are small for stars whose places were not employed in determining the precession constant, whilst the Right Ascensions of these eight stars change by such quantities as

$$-1^m\ 33^s;\ -28^m\ 30^s;\ +10^m\ 20^s;\ +16^m\ 11^s$$
$$+1^h\ 21^m\ 10^s;\ +1^h\ 25^m\ 55^s;\ +10^m\ 36^s;\ \text{and}\ +10^m\ 1^s$$

in 45 years, appears to afford independent evidence of the accuracy of Peters' value of the precession constant.

Name of Star and Adopted Proper Motions.	Year.	Mean R.A. Computed.	Observed.	Computed minus Observed $\delta\alpha \cdot \sin\Delta$.	Mean N.P.D. Computed.	Observed.	Computed minus Observed $\delta\Delta$.	Catalogue.
		h m s	s	s	° ′ ″	″	″	
o Octantis	1860	0 13 24·54	24·93	−0·006	179 8 29·18	29·15	+0·03	Cape, 1860.
+0ˢ·012	1870	0 13 5·43	4·90	+0·008	179 5 8·96	8·88	+0·08	Melbourne, 1870.
0″·00	1880	0 12 50·29	50·31	0·000	179 1 48·73	48·54	+0·19	Cape, 1880.
	1885	0 12 44·00	45·04	−0·018	179 0 8·63	8·20	+0·43	Cape, 1885.
	1885	0 12 44·00	44·82	−0·014	179 0 8·63	8·41	+0·22	Cape, 1885, Appendix I.
A Octantis	1860	8 20 17·14	17·23	−0·002	178 27 23·22	23·27	−0·05	Cape, 1860.
−0ˢ·014	1870	8 13 53·47	53·48	0·000	178 29 15·97	15·87	+0·10	Melbourne, 1870.
−0″·02	1880	8 7 13·28	12·64	+0·017	178 31 3·94	4·39	−0·45	Cape, 1880.
	1885	8 3 46·92	46·51	+0·011	178 31 56·06	56·31	−0·25	Cape, 1885.
	1885	8 3 46·92	46·17	+0·019	178 31 56·06	56·99	−0·93	Cape, 1885, Appendix I.
Brisbane 4091	1860	12 29 50·80	50·82	0·000	179 1 48·36	48·37	−0·01	Cape, 1860.
−0ˢ·088	1880	12 34 45·87	46·00	−0·002	179 8 25·50	25·32	+0·18	Cape, 1880.
0″·00	1885	12 36 10·64	11·96	−0·019	179 10 4·57	4·53	+0·04	Cape, 1885.
	1885	12 36 10·64	10·67	0·000	179 10 4·57	4·66	−0·09	Cape, 1885, Appendix I.
ε Octantis	1860	14 23 43·49	43·66	−0·007	177 33 54·68	54·65	+0·03	Cape, 1860.
−0ˢ·160	1870	14 27 20·95	20·83	+0·005	177 36 36·65	36·43	+0·22	Melbourne, 1870.
+0″·05	1880	14 31 6·17	5·56	+0·025	177 39 16·67	16·64	+0·03	Cape, 1880.
	1885	14 33 1·78	1·75	+0·001	177 40 35·92	35·83	+0·09	Cape, 1885.
	1885	14 33 1·78	0·79	+0·040	177 40 35·92	36·03	−0·11	Cape, 1885, Appendix I.

Name of Star and Adopted Proper Motions.	Year.	Mean R.A. Computed.	Observed.	Computed minus Observed $\delta\alpha \cdot \sin\Delta$.	Mean N.P.D. Computed.	Observed.	Computed minus Observed $\delta\Delta$.	Catalogue.
		h m s	s	s	° ′ ″	″	″	
σ Octantis	1860	17 48 8·80	7·89	+0·011	179 16 40·81	40·94	−0·13	Cape, 1860.
+0ˢ·075	1870	18 6 21·91	22·26	−0·004	179 16 43·40	43·33	+0·07	Melbourne, 1870.
+0″·02	1880	18 24 30·43	29·62	+0·010	179 16 30·02	29·92	+0·10	Cape, 1880.
	1885	18 33 28·93	30·42	−0·019	179 16 17·50	17·06	+0·44	Cape, 1885.
	1885	18 33 28·93	28·62	+0·004	179 16 17·50	16·90	+0·60	Cape, 1885, Appendix I.
B Octantis	1860	20 37 21·08	20·80	+0 003	179 28 51·78	51·96	−0·18	Cape, 1860.
−0ˢ·130	1870	20 55 36·26	36·71	−0·004	179 26 38·60	39·08	−0·48	Melbourne, 1870.
+0″·01	1880	21 11 31·45	31·72	−0·003	179 24 14·64	15·25	−0·61	Cape, 1880.
	1885	21 18 42·24	42·02	+0·002	179 22 59·27	60·17	−0·90	Cape, 1885.
	1885	21 18 42·24	44·15	−0·021	179 22 59·27	59·98	−0·71	Cape, 1885, Appendix I.
C Octantis	1860	22 3 34·62	34·82	−0·012	176 40 24·76	24·79	−0·03	Cape, 1860.
−0ˢ·035	1870	22 5 55·04	54·85	+0·011	176 37 28·18	28·18	0·00	Melbourne, 1870.
−0″·08	1880	22 8 11·88	12·00	−0·007	176 34 30·64	31·34	−0·70	Cape, 1880.
	1885	22 9 19·01	18·77	+0·014	176 33 1·53	2·38	−0·85	Cape, 1885.
	1885	22 9 19·01	18·74	+0·016	176 33 1·53	2·34	−0·81	Cape, 1885, Appendix I.
τ Octantis	1860	23 5 3·02	3·30	−0·009	178 14 55·70	55·73	−0·03	Cape, 1860.
+0ˢ·036	1870	23 7 14·37	14·12	+0·008	178 11 40·50	40·31	+0·19	Melbourne, 1870.
−0″·02	1880	23 9 18·98	19·18	−0·006	178 8 24·89	24·99	−0·10	Cape, 1880.
	1885	23 10 18·93	18·72	+0·007	178 6 46·95	47·33	−0·38	Cape, 1885.
	1885	23 10 18·93	18·84	+0·003	178 6 46·95	47·21	−0·26	Cape, 1885, Appendix I.

On the Proper Motion of the star B.A.C. 793.

By W. T. Lynn, B.A.

In the number of the *Monthly Notices* for May 1875 (vol. xxxv. p. 356) Professor Piazzi Smyth contributed a paper on the proper motion of the star *B.A.C.* 793 (=Piazzi II. 123), suggesting that this was variable in amount, and had sensibly diminished in R.A. and increased in N.P.D. Mr. Dunkin, however, showed from a discussion of the Greenwich observations that there was no real evidence of change of this kind in either element. He followed this up in the number for March 1876 (vol. xxxvi. p. 254), deducing the proper motion of the star from more recent Greenwich observations, which he determined to be $+0^{s}\cdot119$ in R.A. and $-1''\cdot50$ in N.P.D., and remarking that "the proper motion of *B.A.C.* 793 has not really changed during the present century." Mr. Stone also communicated a short paper after Mr. Dunkin's, pointing out that the Cape observations of the star in R.A. (none were available in N.P.D.) did not give any evidence of change in proper motion. The value used in the 9-year Catalogue (slightly modified in the 10-year) is the one determined by Mr. Dunkin, that in N.P.D. being about $0''\cdot2$ larger than the value given in the *B.A.C.*, which is $-1''\cdot31$, and had been adopted in previous Greenwich catalogues.

In a letter of mine which appeared in the number of the *Observatory* for last August, I showed, by comparing the places in the Greenwich 9-year and 10-year Catalogues, that there is some doubt whether after all the *B.A.C.* value of the proper motion in N.P.D. is not nearer the truth.

I will here set down the places derived from all the principal Greenwich catalogues, five of which contain observations of this star. They are as follows:

In R.A.

Catalogue.	Epoch.	h m s	No. of Obs.
12-year (first part)	1840	2 27 18·75	5
6-year (corrected)	1850	2 27 51·81	1
7-year	1860	2 28 24·47	29
9-year	1872	2 29 3·818	13
10-year	1880	2 29 30·084	13

The differences of these give for

	s		s
10 years	+33·06	annually	+3·306
10 years	+32·66	,,	+3·266
12 years	+39·348	,,	+3·279
8 years	+26·266	,,	+3·283

Now the mean annual precessions during these intervals are $+3^s\cdot158$, $+3^s\cdot159$, $+3^s\cdot160$, and $+3^s\cdot161$ respectively, deducting which, we find the resulting proper motion from each comparison $+0^s\cdot148$, $+0^s\cdot107$, $+0^s\cdot119$, and $+0^s\cdot122$, the mean of which is $+0^s\cdot124$. Or taking the difference from the extreme interval, 1840 to 1880, this is $+2^m\ 11^s\cdot334$ for forty years, or $+3^s\cdot283$ annually; thence deducting the mean precession, $+3^s\cdot160$, we obtain $+0^s\cdot123$ for proper motion, which would therefore appear to be a very accurate value.

In like manner:

Catalogue.	Epoch.	*In N.P.D.* N.P.D.	No. of Obs.
12-year (second part)	1845	83° 51′ 21″·82	5
6-year (corrected)	1850	83 49 56·99	1
7-year	1860	83 47 1·88	30
9-year	1872	83 43 31·02	14
10-year	1880	83 41 13·12	12

The differences of these, with the resulting annual changes, are:

5 years	−1′ 24″·83	annually	−16″·96
10 years	−2 55·11	„	−17·51
12 years	−3 30·86	„	−17·57
8 years	−2 17·90	„	−17·24

The mean annual precessions during these intervals are $-16''\cdot02$, $-16''\cdot01$, $-15''\cdot98$, and $-15''\cdot95$ respectively, deducting which we find the resulting value of proper motion from each comparison $-0''\cdot94$, $-1''\cdot50$, $-1''\cdot59$, and $-1''\cdot29$ respectively, the mean of which is $-1''\cdot33$. Or, taking the difference from the extreme interval, 1845 to 1880, this amounts to $-10'\ 8''\cdot70$ for thirty-five years, or $-17''\cdot39$ annually; thence deducting the mean precession, $-15''\cdot99$, we obtain $-1''\cdot40$ for proper motion, of which, therefore, $-1''\cdot37$ would appear to be the most accurate value.

By the kind permission of the Astronomer Royal I am able to confirm and improve the above calculation by means of places derived from observations made at the Royal Observatory, Greenwich, in 1893 and 1894, but not yet published. These, reduced to the beginning of each year (none were made in 1891 or 1892), are as follows:

Year.	R.A. h m s	No. of Obs.	N.P.D.	No. of Obs.
1893	2 30 12·715	2	83° 37′ 26″·86	2
1894	2 30 16·028	5	83 37 9·35	5

Now a comparison of these places with those given in the 9-year Catalogue, the epoch of which is more than twenty years

anterior to their dates, leads to a proper motion of about $+0^{s}\cdot119$ in R.A. and $-1''\cdot43$ in N.P.D. It would seem, then, that the most probable value of the proper motion of this star is $+0^{s}\cdot121$ in R.A. and $-1''\cdot40$ in N.P.D. The latter value is about $0''\cdot1$ larger than that in the *B.A.C.*, and about $0''\cdot1$ smaller than that determined by Mr. Dunkin from earlier Greenwich observations. *Prima facie*, indeed, there is almost room for suspicion that the proper motion in N.P.D. is slowly increasing, though of course not in the way suggested by Professor Piazzi Smyth, which was founded on misconception.

Blackheath:
1895 *March* 4.

On the Proper Motion of the Star Cephei 24 (*Hev.*).

By W. T. Lynn, B.A.

In the Introduction to the eighth volume of the *Madras Observations*, which has been recently published, Mr. Michie Smith remarks that this star (which had been used for meridian error at Madras) had no proper motion assigned to it in the Greenwich 9-year Catalogue, but that there is little doubt that it has one considerable in amount. It is of the fifth magnitude, and is numbered 3402 in Groombridge's Catalogue, and Carrington considered that it had an appreciable proper motion. Mr. Stone follows the B.A.C. (where it is No. 7184) in locating it in *Ursa Minor*.

I have made an approximate determination of the proper motion, and herewith offer it to the Society, remarking that it can only be considered provisional, as the fractional proper motions have not been applied in the Catalogues, but it may form a basis for doing so in future. The star is included in both the Greenwich 7-year Catalogues, in the Greenwich 9-year, and in the last Radcliffe Catalogue for 1890. The places in each of these are as follows :—

Gr. 7-year Cat. 1860 ; R.A. $20^{h}\ 31^{m}\ 5^{s}\cdot49$ (5 obs.), precession $-43^{s}\cdot554$, sec. var. $-23^{s}\cdot6447$.

N.P.D. $1°\ 17'\ 57''\cdot68$ (8 obs.), precession $-12''\cdot27$, sec. var. $+5''\cdot029$.

Gr. 7-year Cat. 1864 ; R.A. $20^{h}\ 28^{m}\ 10^{s}\cdot22$ (2 obs.), precession $-44^{s}\cdot483$, sec. var. $-24^{s}\cdot0088$.

N.P.D. $1°\ 17'\ 7''\cdot94$ (4 obs.), precession $-12''08$, sec. var. $+5''\cdot184$.

Gr. 9-year Cat. 1872 ; R.A. $20^{h}\ 22^{m}\ 11^{s}\cdot693$ (4 obs.), precession $-46^{s}\cdot4169$, sec. var. $-24^{s}\cdot6431$.

N.P.D. 1° 15′ 32″·52 (4 obs.), precession — 11″·660, sec. var. + 5″·513.

Radcliffe Cat. 1890 ; R.A. $20^h\ 7^m\ 39^s{\cdot}885$ (5 obs.), precession $-\ 50^s{\cdot}9643$, sec. var. $-\ 25^s{\cdot}6826$.

N.P.D. 1° 12′ 10″·57 (5 obs.), precession — 10″·603, sec. var. + 6″·313.

The interval between the epochs of the last two Catalogues is eighteen years, and the places are each founded in both elements upon not fewer than four observations. Reducing the Greenwich 9-year place to 1890 by precession only, allowing for its change, we obtain R.A. $20^h\ 7^m\ 35^s{\cdot}255$, N.P.D. 1° 12′ 12″·16. And as the Radcliffe place for that year is R.A. $20^h\ 7^m\ 39^s{\cdot}885$, N.P.D. 1° 12′ 10″·57, the resulting proper motion for eighteen years is $+\ 4^s{\cdot}630$ and — 1″·59, making its annual value $+\ 0^s{\cdot}37$ in R.A. and — 0″·09 in N.P.D. Comparison between the earlier Greenwich Catalogues essentially confirms this, only making the proper motion in R.A. a little larger (about $+\ 0^s{\cdot}42$), and also that in N.P.D. Comparison between the earliest Greenwich (7-year Cat. 1860) Catalogue in which the star is included and the Radcliffe, the interval between which is thirty years, gives a similar result, $+\ 0^s{\cdot}405$ in R.A. and — 0″·13 in N.P.D. ; so that there is no doubt the approximate value of this star's proper motion is $+\ 0^s{\cdot}4$ in R.A. and —0″·1 in N.P.D., exceeding that of Groombridge, 1830, in the former element.

I have been led to examine also the proper motion of the star 24 *Cephei*, i.e. that (Mag. 5-4) numbered 24 in Flamsteed's list of stars in that constellation, which is known to be very small. It is included in the Greenwich 6-year, the two Greenwich 7-year, the Greenwich 9-year, and the Radcliffe Catalogue for 1890. In the later Greenwich Catalogues the proper motion $+\ 0^s{\cdot}003$, + 0″·03 is adopted ; in the Radcliffe, $+\ 0^s{\cdot}002$, + 0″·007. A comparison of the places, however, in these would give one somewhat larger in N.P.D., whilst that in R.A. is clearly quite inappreciable. The places are as follows :

	R.A.	No. of Obs.	N.P.D.	No. of Obs.
	h m s		° ′ ″	
Greenwich 9-year	22 7 20·527	6	18 17 20·43	7
Radcliffe for 1890	22 7 41·387	6	18 12 2·95	7

The variations from these are in R.A. $+\ 20^s{\cdot}860$ for eighteen years, annual, $+\ 1^s{\cdot}159$; in N.P.D., — 5′ 17″·48 for eighteen years, annual, — 17″·64. And as the mean annual precession in the two elements is $+\ 1^s{\cdot}1607$ and — 17″·686 respectively, this comparison would give for proper motion $-\ 0^s{\cdot}002$ in R.A. and + 0″·05 in N.P.D.

Blackheath :
1895 *March* 1.

Observations of the Vertical Diameter of the Planet Jupiter.

By T. J. Moore, Field House, Hatfield, Doncaster.

(*Communicated by Dr. A. M. W. Downing.*)

Telescope used 5-inch reflector, power 125 and 50 diameter s with Slade's micrometer.

1892.	No. of Observations.	Mean Value of one Night's Observations (vertical diameter).	Observed diameter reduced to dist. 5'20.	Obs. Vertical Diameter reduced to the Polar Value at dist. 5'20.	Error made on one night's observation, mean value =36″·11.
1892.					
Oct. 18	20	48″·03	36″·59	36″·16	+0″·05
25	40	47·93	36·75	36·32	+0·21
29	30	47·15	36·30	35·87	−0·24
Nov. 3	50	46·36	35·97	35·54	−0 57
10	40	45·95	36·14	35·71	−0·40
30	20	43·66	36·11	35·68	−0·43
Dec. 1	20	44·46	36·95	36·52	+0·41
2	10	44·07	36·75	36·33	+0·22
5	20	43·58	36·68	36·25	+0·14
6	20	43·08	36·38	35·95	−0·16
12	20	41·52	35·74	35·31	−0·81
13	10	41·67	36·00	35·57	−0·54
15	20	41·96	36·48	36·05	−0·06
1893.					
Nov. 22	20	47·93	37·17	36·99	+0·88
28	14	46·86	36·48	36·30	+0·19
Dec. 4	20	46·20	36·21	36·03	−0·08
5	5	46·38	36·39	36·21	+0·10
6	20	46·40	36·46	36·28	+0·17
7	20	46·58	36·66	36·48	+0·37
8	20	45·98	36·25	36·07	−0·04
9	20	45·38	35·83	35·65	−0·46
11	20	45·85	36·33	36·15	+0·04
12	20	45.92	36·41	36·23	+0·11
14	40	45·88	36·57	36·39	+0·28
15	20	45·77	36·55	36·37	+0·26
20	21	44·42	35·87	35·69	−0·42

1892.	No. of Observations.	Mean Value of one Night's Observations (vertical diameter).	Observed diameter reduced to dist. 5·20.	Obs. Vertical Diameter reduced to the Polar Value at dist 5·20.	Error made on one night's observation, mean value = 36″·11.
1893.		″	″	″	″
Dec. 22	40	44·54	36·14	35·96	−0·15
23	20	44·88	36·50	36·32	+0·21
1894.					
Dec. 22	20	45·26	36·19	36·16	+0·05
26	20	45·15	36·12	36·09	−0·02
27	12	45·34	36·30	36·27	+0·16
29	30	45·50	36·47	36·44	+0·33
1895.					
Jan. 2	20	45·30	36·42	36·39	+0·28
4	20	45·12	36·35	36·32	+0·21
5	20	45·11	36·38	36·35	+0·24
18	40	43·51	35·80	35·77	−0·34
21	20	43·92	36·56	36·53	+0·42
22	20	43 35	35·97	35·94	−0·17
23	20	43·67	36·32	36·29	+0·18
24	5	43·76	36·47	36·44	+0·33
25	3	43·56	36·39	36·36	+0·25
Feb. 11	10	41 08	35·90	35·87	−0·24
14	10	40·86	36·06	36·03	−0·08
23	10	40·07	36·37	36·34	+0·23
25	20	39·54	36·12	36·09	−0·02
27	20	38·94	35·80	35·77	−0·34
Total	960		Observations =	36″·11	

				Vert. Diam.	Correction.	Polar Diam.	Power.
From	320	obs.	1892	= 36″·37	−0″·43	= 35″·94	125
,,	320	,,	1893	= 36·39	−0·18	= 36·21	125
,,	320	,,	1894–5	= 36·22	−0·03	= 36·19	50
Total	960	,,	Mean Polar Value			= 36″·11 at dist. 5·20	

In the reduction of these observations to the True Polar Value the compression of the polar axis is assumed to be $\frac{1}{16}$.

Results of Double-star Measures with the 8-inch Equatorial at Windsor, New South Wales, in 1894.
By John Tebbutt.

Ref. No.	Star.	Observed Magnitude	Approx. Place of Star. R. A.	Dec. S.	Fraction of Year.	Position Angle.	No. of Obs.	Distance.	No. of Obs.	Mag. Power.	Eyes.	Hour-angles.		Weight, 1 to 5.
			h m	° ′		°		″				h m	h m	
1	β Phœnicis	5, 5	1 1·4	47 17	·838	21·8	10	1·68	8	300	P	1 33 E	1 1 E	5
2	,,	5, 5	,,	,,	·841	22·5	10	1·80	10	300	P	3 25 E	2 58 E	5
3	,,	...	,,	,,	·846	23·2	10	...	...	300	P	3 19 E	2 59 E	3
4	,,	...	,,	,,	·849	24·9	10	1·45	10	300	P	3 18 E	2 51 E	5
5	ζ Phœnicis	4, 8	1 3·9	55 49	·890	243·2	10	...	...	230	P	1 35 E	1 1 E	2
6	,,	4, 8	,,	,,	·890	...	...	6·52	8	138	P			3
7	κ Toucani	5, 7	1 12·2	69 26	·846	354·9	10	5·50	10	300	P	2 49 E	2 18 E	4
8	,,	$5\frac{1}{2}$, 8	,,	,,	·849	354·9	10	5·49	10	300	R	2 47 E	2 18 E	4
9	,,	5, 8	,,	,,	·887	354·4	10	5·58	10	300	R	1 5 E	0 33 E	5
10	h 3447	...	1 31·2	30 27	·846	90·7	10	...	...	300	P	2 9 E	...	4
11	,,	$5\frac{1}{2}$, 8	,,	,,	·849	92·0	10	2·05	8	300	P	1 58 E	1 27 E	4
12	,,	6, $8\frac{1}{2}$	,,	,,	·884	91·4	10	2·16	7	300	R	1 45 E	1 19 E	4
13	,,	6, $8\frac{1}{2}$	,,	,,	·887	91·3	10	2·07	8	300	R	2 16 E	1 51 E	4
14	p Eridani	...	1 35·8	56 44	·772	...	...	7·59	10	170	R	5 4 E	4 47 E	4
15	,,	...	,,	,,	·772	...	...	7·37	10	170	P	1 54 E	1 34 E	5
16	,,	...	,,	,,	·775	...	...	7·26	10	170	R	4 32 E	4 14 E	4
17	,,	...	,,	,,	·775	222·9	7	...	...	300	P	3 53 E	3 21 E	3
18	,,	...	,,	,,	·780	225·3	20	6·99	10	300	P	3 55 E	3 13 E	4
19	,,	...	,,	,,	·789	224·4	10	7·34	10	300	P	...	3 21 E	5

Ref. No.	Star.	Observed Magnitude.	Approx. Place of Star. R. A.	Dec. S.	Fraction of Year.	Position Angle.	No. of Obs.	Distance.	No. of Obs.	Mag. Power.	Eyes.	Hour-angles.		Weight, 1 to 5.
			h m	° ′		°		″				h m	h m	
20	*p* Eridani	...	1 35·8	56 44	·805	225·0	10	7·39	10	300	P	2 11 E	1 37 E	5
21	,,	...	,,	,,	·808	225·4	10	7·41	10	300	R	3 22 E	2 51 E	5
22	,,	...	,,	,,	·813	226·2	10	...	...	300	R	3 58 E	3 30 E	3
23	,,	...	,,	,,	·816	224·8	10	7·41	10	300	P	2 38 E	2 8 E	4
24	,,	...	,,	,,	·819	224·5	10	...	...	300	P	3 47 E	3 28 E	3
25	,,	$5\frac{1}{2}$, $5\frac{1}{2}$	,,	,,	·975	227·0	10	7·33	8	300	R	2 12 W	2 48 W	4
26	*h* 3592	6, 9	3 41·9	54 36	·838	17·0	10	5·28	10	138	P	3 20 E	2 36 E	5
27	,,	6, 9	,,	,,	·887	16·6	10	5·63	10	138	P	2 46 E	2 15 E	5
28	Lac. 2145	7, 7	6 2·0	48 27	·884	33·5	10	1·88	10	300	P	3 59 E	3 27 E	4
29	,,	7, 7	,,	,,	·967	31·8	10	1·60	8	300	P	2 51 E	2 24 E	5
30	,,	7, 7	,,	,,	·972	32·2	10	...	...	300	P	3 7 E	2 47 E	3
31	,,	7, 7	,,	,,	·975	31·2	10	1·52	10	300	P	3 4 E	2 32 E	3
32	α Centauri	...	14 32·4	60 24	·758	...	...	20·87	5	170	...	3 34 W	3 46 W	4
33	,,	...	,,	,,	·758	...	...	21·06	7	170	P	3 46 W	4 0 W	4
34	,,	...	,,	,,	·767	...	...	20·57	7	170	R	1 2 W	1 15 W	2
35	,,	...	,,	,,	·767	...	...	20·89	7	170	P	3 16 W	3 33 W	3
36	,,	...	,,	,,	·767	...	...	20·67	10	170	P	3 27 E	3 2 E	3
37	,,	...	,,	,,	·769	...	...	20·59	8	170	R	0 54 W	1 29 W	4
38	,,	...	,,	,,	·772	...	...	20·60	10	170	P	4 24 W	4 40 W	4
39	,,	...	,,	,,	·775	...	...	20·70	10	170	P	3 43 W	3 57 W	4
40	,,	...	,,	,,	·780	208·1	10	...	...	140	P	2 26 W	2 41 W	3

Ref. No.	Star.	Observed Magnitude.	Approx. Place of star. R. A. h m	Dec. S. ° ′	Fraction of Year.	Position Angle. °	No. of Obs.	Distance. ″	No. of Obs.	Mag. Power.	Eyes.	Hour-angles. h m	h m	Weight, 1 to 5.
41	α Centauri	...	14 32·4	60 24	·780	208·1	10	...	...	300	P	3 30 W	3 42 W	4
42	,,	...	,,	,,	·789	208·7	10	20·69	10	140	R	1 34 W	2 6 W	4
43	,,	...	,,	,,	·789	207·3	10	20·74	10	300	P	3 0 W	3 34 W	3
44	,,	...	,,	,,	·789	208·4	10	...	...	300	R	3 39 W	3 49 W	3
45	,,	...	,,	,,	·789	208·4	10	...	...	300	P	3 49 W	4 0 W	3
46	,,	...	,,	,,	·802	207·3	10	20·59	10	300	P	4 28 W	5 3 W	4
47	,,	...	,,	,,	·805	208 0	10	...	...	300	P	4 6 W	4 20 W	3
48	,,	...	,,	,,	·805	208·2	10	...	...	300	R	4 47 W	4 57 W	4
49	,,	...	,,	,,	·808	208·1	10	...	...	300	P	2 55 W	3 10 W	4
50	,,	...	,,	,,	·808	208·1	10	...	...	300	R	3 12 W	3 22 W	4
51	γ Coronæ Aust.	...	18 59·3	37 13	·772	...	...	1·82	10	170	R	0 49 W	1 9 W	3
52	,,	...	,,	,,	·775	...	...	1·57	10	170	P	1 34 W	1 50 W	5
53	,,	...	,,	,,	·789	166·4	9	1·47	10	300	P	1 48 W	2 19 W	4
54	,,	...	,,	,,	·805	165·4	10	1·56	10	300	P	2 10 W	2 41 W	5
55	,,	...	,,	,,	·808	165·0	10	1·56	10	300	P	2 12 W	2 42 W	5
56	,,	$6\frac{1}{2}$, $6\frac{1}{2}$	,,	,,	·819	165·5	10	...	...	300	P	3 29 W	3 48 W	5
57	,,	...	,,	,,	·824	165·3	10	1·71	8	300	P	4 40 W	5 25 W	5
58	Lac. 8550	7, 7	20 42·8	62 49	·819	94·9	10	...	...	300	R	2 19 W	2 48 W	4
59	,,	...	,,	,,	·821	94·9	10	2·28	10	300	P	1 16 W	1 58 W	4
60	,,	...	,,	,,	·824	95·7	10	·88	10	300	R	2 5 W	2 43 W	5
61	h 5295$\frac{2}{3}$	6, $8\frac{1}{2}$	21 41·4	47 47	·895	359·8	...	44·31	5	74	P	2 35 W	3 11 W	4
62	,,	6, $8\frac{1}{2}$	,,	,,	·895	359·8	...	44·36	5	112	P			4

Ref. No.	Star.	Observed Magnitude.	Approx. Place of Star. R. A.	Dec. S.	Fraction of Year.	Position Angle.	No. of Obs.	Distance.	No. of Obs.	Mag. Power.	Eyes.	Hour-angles.		Weight, 1 to 5
			h m	° ′		°		″				h m	h m	
63	*h* 5295⅔	6, 8½	21 41·4	47 47	·904	359·8	...	44·44	10	74	P	3 0 W	3 28 W	4
64	„	6, 8	„	„	·967	359·8	...	44·50	7	74	P	3 7 W	4 4 W	4
65	„	6, 8½	„	„	·967	0·3	10	44·70	10	138	P	4 20 W	4 52 W	4

Remarks.

In the column headed "Eyes" P denotes that the line joining the observer's eyes was parallel to that joining the components, and R that these lines were at right angles. The column headed "Hour-angles" gives the hour-angles between which the measures were made, and that headed "Weight" gives the value of each result on a scale of 1 to 5, 1 denoting the worst possible, and 5 the best possible conditions.

With the exception of Nos. 14, 15, 16, 32, 33, 34, 35, 36, 37, 38, 39, 51, 52, 61, 62, 63, 64, the measures were made with the Cooke position filar micrometer. These measures were made with the Grubb filar micrometer without a position circle. No. 32 is the result of measured differences of declination with an assumed position angle = 208°.

For Nos. 14, 15, 16, 33, 34, 35, 36, 37, 38, 39, 51, 52, the transit thread was set parallel to the components, but for Nos. 61, 62, 63, 64 the distance threads were set parallel to the star's diurnal path. It was found during these four sets of measures that the components were together accurately bisected by the transit thread, so that the position angle is adopted as 359° 8, a small correction being applied for an error in the perpendicularity of the transit and distance threads. Nos. 32 to 50, both included, were observed in sunlight, and Nos. 2 and 3 in twilight.

The components of Nos. 1, 2, 4, 14, 15, 22, 23, 24, 25, 28, 29, 30, 51, 56, 58 were noted to be equal. Of Nos. 5 and 6 the primary was white and the companion pale blue.

The position angle of Nos. 10, 11, 12, 13 has increased about 15° since 1836. Hargrave, of Sydney, states that he could not divide the components in 1882 with a power of 333. As his position for the star is considerably in error, it is probable that he has mistaken another object for Herschel's star.

Of Nos. 26 and 27 the primary is straw yellow, and the companion bluish.

The south component of No. 31 was very slightly the brighter.

The position angle of Nos. 28, 29, 30, 31 has increased 50°, and the distance diminished 2″ since Herschel's observations in 1835. The position angle of Nos. 61, 62, 63, 64, 65 has diminished 14°, and the distance increased 14″ since 1836. The change is probably due to proper motion of the smaller star.

Windsor, N.S. Wales: 1895 *January* 15.

A List of Probably New Double Stars. By R. T. A. Innes.

During the last two months whilst I had the loan of a telescope belonging to Mr. W. F. Gale, of Sydney, I came across the double stars in the following list, all of which I believe are new. The telescope had a $6\frac{1}{4}$-inch object glass, made by T. Cooke, York, 1851, and was mounted on a rough equatorial without circles. The eyepiece used gave a power of about 360. I puzzled out the stars found, with the help of Proctor's smaller Atlas and Stone's Cape Catalogue, with fair success, but I generally add a note in reference to neighbouring stars, which will render the identification easier. The positions are for 1900. Angles, &c., are estimations. This list, the result of about thirty hours' searching, will prove what a mine of wealth awaits the diligent double-star observer in the southern hemisphere.

On account of the difficulty of identifying stars I confined my search to the neighbourhood of naked-eye stars, and only registered those which required some attention to notice their duplicity. None of these stars are in Herschel's or the Sydney Observatory lists.

G 1	Stone 1830	$4^h\ 14^m{\cdot}8$	$-61°\ 12'$
1894·8	$300° \pm$	$0''{\cdot}8 \pm$	$5\frac{1}{2}$ and 7 2n

G 2	ξ Pavonis	$18^h\ 14^m{\cdot}0$	$-61°\ 32'$
1894·8	$170° \pm$	$4''{\cdot}0 \pm$	5 and 10·7 2n.

Detected by Mr. Gale with his $8\frac{1}{2}$-inch, previously to my seeing them.

No. 1	λ^1 Toucanæ	$0^h\ 49^m{\cdot}4$	$-63°\ 25'$
1894·9	$90° \pm$	$3'' \pm$	6 and 8·5 1n.

This star is marked double in Proctor's smaller Atlas, whilst λ^2 *Toucanæ*, a double discovered by Dunlop, is not so marked. Professor Auwers in his proposed list of southern standard stars also overlooked the duplicity of λ^2.

No. 2	St. 1746	$4^h\ 1^m{\cdot}1$	$-59°\ 51'$
1894·9	$90° \pm$	$2'' \pm$	7·5 and 9 1n.

The S star of a small finder pair making a right angle with ϵ and ι Reticuli :

No. 3	St. 2879	$6^h\ 11^m{\cdot}5$	$-61°\ 27'$
1894·8	$350° \pm$	$0''{\cdot}8 \pm$	6·5 and 7 2n.

No. 4	St. 3041	$6^h\ 27^m{\cdot}4$	$-40°\ 22'$
1894·9	340° ± 1″ ±	6 and 6·1	2n.

The leading star of an oblong of six as seen through the finder.

No. 5	St. 3148	$6^h\ 36^m{\cdot}9$	$-61°\ 27'$
1894·9	270° ± 1″·7 ±	6·5 and 8·5	2n.
No. 6	St. 3213	$6^h\ 43^m{\cdot}5$	$-61°{\cdot}7'$
1894·9	230° ± 1″·1 ±	7·8 and 7·8	2n.
No. 7	St. 3567	$7^h\ 14^m{\cdot}6$	$-46°\ 49'$
1894·9	220° ± 1″·5 ±	7 and 9·5	1n.

Both orange. The fourth star of five in a sickle—

No. 8	St. 4085	$7^h\ 59^m{\cdot}2$	$-44°\ 23'$
1894·9	320° ± 4″ ±	6 and 10	1n.
No. 9	St. 4287?	$8^h\ 15^m{\cdot}9$	$-73°\ 30'$
1894·8	280° ± 0″·9 ±	6 and 7	1n.

An eleventh mag. star 1′ N *f*.

No. 10	δ Argûs	$8^h\ 41^m{\cdot}9$	$-54°\ 20'$
1894·9	180° ± 3″ ±	2·5 and 5	2n.

As this star is much more difficult than *Antares* (2″·8), the distance is probably overestimated. Herschel noted a faint companion 80″ away.

No. 11	St. 4939	$9^h\ 11^m{\cdot}6$	$-45°\ 8'$
1894·9	270° ± 1″ ±	6·5 and 7	1n.
No. 12	St. 5008	$9^h\ 17^m{\cdot}6$	$-74°\ 28'$
1894·8	290° ± elongated	5 and 6	1n
1894·9	Round, good seeing		1n.

This is the chief star of the triple *h* 4206.

No. 13	St. 5534	$10^h\ 7^m{\cdot}0$	$-68°\ 11'$
1894·9	340° ± 1″ ±	7 and 7	1n.

Both white. This is the brightest of the stars ϖ *Argus*, and is N from it.

No. 14	Anon.	$12^h\ 6^m \pm$	$-51°\ 35' \pm$
1894·9	$140° \pm$	$3'' \pm$	7 and 9·5 in.

Not in Stone's Catalogue. Just N of ρ *Centauri*.

No. 15	St. 8844	$16^h\ 10^m·7$	$-64°\ 24'$
1894·8	$300° \pm$	$0''·8 \pm$	7 and 9 2n.

R 275, a coarse ninth mag. pair is about 5′ N *p*.

No. 16	St. 2674	$5^h\ 49^m·5$	$-38°\ 33'$
1894·9	$110° \pm$	$1'' \pm$	6 and 10 large star, orange, 1n.

The brightest star in finder S of η *Pavonis*.

No. 17	St. 11035	$20^h\ 37^m·8$	$-50°\ 51'$
1894·8	$210° \pm$	$1'' \pm$	$7\frac{1}{2}$ and $7\frac{1}{2}$ 2n.

This makes a small triangle with some other 7 mag. stars near ι and η Indi. It is a coarse double 7 and 7, $90° \pm 100'' \pm$, and the preceding star is the close double.

No. 18	St. 11109	$20^h\ 48^m·0$	$-53°\ 58'$
1894·8	$0° \pm$	$5'' \pm$	7 and $11\frac{1}{2}$ 2n.

The chief star is red. If a line is drawn from α Indi through η Indi, two stars will be found on it. S of η Indi, this is the second star.

No. 19	Anon.	$21^h\ 41^m \pm$	$66°\ 10' \pm$	
1894·9	A and B	$350° \pm$	$0''·8 \pm$	7·8 and 10 1n
	A and C	$290° \pm$	$10'' \pm$	12 1n.

Very delicate ; about 1° S. of St. 11489.

No. 20	St. 11660	$22^h\ 9^m·3$	$-63°\ 50'$
1894·9	$320°$	$0''·6$	6·5 and 7 1n.

Midway on a line joining α and δ *Toucani* will be found St. 11673 : this star is N *p*.

No. 21	St. 11835	$22^h\ 36^m·6$	$-47°\ 43'$
1894·9	$140° \pm$	$5'' \pm$	6 and 11·5 1n.

Chief star orange. This and *h* 5362, a star of the same style, but easier, are both near β *Gruis*.

No. 22	τ^2 Gruis	$22^h\ 49^m·5$	$-49°\ 0'$
1894·9	$200° \pm$	$0''·6 \pm$	6·5 and 8·0 3n.

Only elongated, but quite certain. τ^2 *Gruis* is 90″ N. of St. 11933.

No. 23	St. 12156	$23^h\ 22^m{\cdot}6$	$-56°\ 59'$
1894·9	$320° \pm\ 1'' \pm$	8 and 10	2n.
No. 24	St. 12192	$23^h\ 27^m{\cdot}9$	$-57°\ 35'$
1894·8	$220° \pm\ 2'' \pm$	6·5 and 9	3n.

This star is 90″ N. of another 6·5 mag. star.

No. 25	Anon.	$23^h\ 29^m \pm$	$-58°\ 14' \pm$
1894·9	$50° \pm\ 1'' \pm$	7·8 and 7·8	1n.

Near St. 12192 ; in the telescope field this is the preceding star of an elongated cross.

No. 26	St. 4019	$7^h\ 54^m{\cdot}4$	$-47°\ 37'$
1894·9	$10° \pm\ 71''$	6 and 7	One third of the way from R Puppis towards γ Argûs.

Sydney, N.S.W.:
1894 *December* 10.

Note from author dated 1895 *January* 25.—"I find that No. 2 was measured by Mr. Sellors in 1891 (see *Ast. Nach.* No. 3154) ; also that Nos. 21 and 24 were observed on the meridian some years ago at Cordoba, and the *Comes* noted at the same time. Consequently these three stars are not new."

The Transit of Mercury, 1894 *November* 10. By Walter F. Gale.

The transit of *Mercury*, so far as it was visible in New South Wales, was well seen by eight observers in Sydney.

At the time of egress definition was noted by me as very good. My internal contact was probably early, but the more difficult external contact was recorded as exceptionally satisfactory. The following times were registered by counting the beats of the sidereal chronometer, which was previously and subsequently verified :

	h	m	s	
Internal contact at egress, Nov. 10 ...	9	11	30·8	G.M.T.
External „ „ „ ...	9	13	23	„

My position is $10^h\ 4^m\ 54^s{\cdot}79$ E. $-33°\ 53'\ 12''{\cdot}3$.

Mercury appeared as an intensely black circular object, without fringe or detail of any kind. The umbra of a Sun-

spot, near which the planet passed, was decidedly less black than *Mercury*.

The instrument used was the $8\frac{1}{2}$-inch equatorial reflector, aperture reduced to 5 inches and provided with a Sun diagonal and achromatic eyepiece magnifying 96 diameters.

Paddington, Sydney, N.S.W.:
1894 *November* 14.

The Transit of Mercury, 1894 *November* 11; *Egress.* By J. P. Thomson, F.R.S.G.S., &c., President of the Royal Geographical Society of Australasia, Brisbane.

(*Communicated by the Secretaries.*)

The instrument used to observe the transit of *Mercury* was an equatorially mounted refracting telescope, 6 feet focal length, with object-glass 6 inches in diameter, built by Sir Howard Grubb in 1884. It is the property of Mr. F. D. G. Stanley, F.R.I.B.A. The telescope rests on a hollow cast-iron column, 5 feet 9 inches in height, and 18 inches diameter at the base, in which is placed the driving clock. The whole metal work is mounted on a stone and concrete foundation carried down to the solid rock 6 feet below the surface of the ground, perfect freedom from vibration being thereby secured.

The observatory, which is situated at "Ardincraig," Toowong, the private residence of Mr. Stanley, is a wooden building, 12 feet square, with roof arranged so as to roll entirely off on a railway and framing built to receive it. There can be no doubt whatever that, in a fine climate, this arrangement possesses many advantages to which I shall refer later on. Included in the equipment of the observatory is a transit instrument, by Carl Bamberg, of Berlin (1879). This is placed upon a stone pedestal. The observations are taken through the hollow central axis of the instrument, the eyepiece being fitted with micrometer. A magnifying power of 100 diameters was used in the equatorial for the actual observation of the transit, this having been found, after repeated tests, to give the most perfect definition. The object-glass of the telescope was stopped down to 3 inches.

The party consisted of his Excellency General Sir Henry Wylie Norman, Governor of Queensland, Messrs. F. D. G. Stanley, and Arthur Cleminson, of the Surveyor-General's Staff, time recorders, and myself, who observed the transit. There were three chronometers used, namely:—No. 542, mean time, by Frodsham, in charge of his Excellency the Governor; No. 2139, also mean time, by Arnold, in the hands of Mr. Stanley, and No. 4230, sidereal, by Kullberg, under the care of Mr. Cleminson. The first belongs to Mr. Stanley's observatory, but the others, one of which is the property of the Hon. A. C. Gregory, were

duly compared with the standard clock at the Brisbane City observatory for several days previous, and late on Saturday night, immediately before Mr. Cleminson and I transported them to Toowong, the former gentleman finally checked them by meridian stars. After the transit had been observed the chronometers were at once returned to the City observatory and recompared. No. 4230 was found to have undergone no change whatever in transit, but there was a very slight displacement observed in the rate of the mean time chronometer. This recalls to my mind a similar experience at the time I was preparing to observe the transit of *Venus* at Levuka, Fiji, in 1882. On that occasion three chronometers were also rated, although only one, the best, was actually used to record the times of the observations. Some two weeks before the date of the transit they were transported with the greatest possible care for a very short distance from the Harbour Master's Office to the observatory, when it was found that a very slight change of rate had taken place.*

Weather.—Shortly after 5 o'clock the sun rose above a clear horizon free from the slightest trace of haze. The whole sky was cloudless, the weather nearly a dead calm, and the atmosphere almost phenomenally steady and agreeably warm. A few preceding days of fine clear dry weather had happily dissipated the moisture accumulated in the atmosphere during previous daily showers, and thus we were privileged to conduct the observations under the most favourable conditions, in every respect typical. After considerable experience in astronomical work, I can honestly state that in no climate have I ever conducted astronomical observations under more favourable atmospheric conditions than those prevailing at Brisbane on the morning of 1894 November 11. A fair idea of these may be conveyed by stating that from sunrise till shortly before the internal contact the planet appeared against the solar surface as a clear and sharply defined disc through a small portable telescope which Mr. Stanley had placed outside the observatory door, and Mr. C. B. Lethem, observing with a 5-inch theodolite at Clayfield, some six miles north-east of our position, was able to record the interval of time between internal and external contacts by an ordinary watch to within 17 seconds of the calculated interval. I have purposely emphasised this description of the weather, having long ago arrived at the conclusion that the so-called black drop and other somewhat remarkable phenomena associated with the observations of the transit of planets are due to terrestrial causes, and not celestial. In other words, they arise from unfavourable atmospheric conditions, from telescopic defect, or from some peculiarity in the physical condition of observers, either one or all combined. This subject has, I may state, been very ably elucidated by the distinguished astronomer Mr. H. C. Russell in

* *Proceedings and Transactions of the Royal Geographical Society of Australasia. Queensland*, vol. vii. p. 93.

a valuable paper upon the previous transit of *Mercury*, contributed to the Royal Society of New South Wales, 1881 December 7. My own experience entirely confirms the views advanced by Mr. Russell.

The Observations.—At 5 hours 10 minutes the equatorial was pointed to the Sun. The several small clusters of spots which had been observed on the solar surface for some few days previous were clearly visible as the Sun gradually cleared the neighbourhood of the horizon. There was no difficulty whatever in distinguishing the planet, for *Mercury* at once appeared in the field as a most perfect sphere, intensely black, with remarkably clear and sharply defined periphery. For some time I sat intently watching this interesting object as it slowly moved across the great solar surface. Particular attention was given to an examination of the effect of different magnifying powers and of various intensities of light by a manipulation of the combination of dark glasses used in the eyepiece of the telescope, but this produced no change whatever in the appearance of the planet. The definition was perfect, and there was not the slightest trace of haze, band of light, or vaporous aureola around the disc of *Mercury*. Attention was next bestowed upon a very minute white spot that appeared upon the surface of the planet. I was aware that a similar object had been noticed by several observers during previous transits, although I had failed to see anything of the kind at the transit of 1881, which I observed with a small telescope under distressing conditions. In this instance the steady, unchangeable appearance of the object left no doubt in my mind whatever that it was something more tangible than an optical illusion. I removed the lower magnifying power, and applied one of 450 diameters, and at first thought I saw two white spots close together, but after the eye had accommodated itself to the change the second spot assumed a very uncertain appearance, and for this reason I doubt its existence altogether; the first, however, remained unchanged. When about to observe internal contact, I was somewhat startled by what appeared, for the moment, to be a slight indication of ligament, but the phenomenon was only momentary, and I regard it as purely optical. When external contact occurred the limb of the Sun and that of the planet were remarkably clear, sharp, and well defined. There was not the slightest trace of disturbance in the limbs of the two bodies, and I have every confidence in recording the phase as a pure geometrical contact.

I very carefully watched for the planet when it separated from the Sun, but no trace of its periphery could be distinguished from the dark space beyond.

Taking the mean of the three chronometer records, the following are the corrected times of the observations, namely—

	h	m	s
Internal contact	7	23	42·45
Geometrical external contact ...	7	25	28·00

The above are the mean times at Brisbane Observatory in latitude 27° 29′ 0″·2 S., and longitude $10^h\ 12^m\ 0^s$ E. We occupied a position of about 6534 feet south and 10,428 west of the Brisbane Observatory.

Regarding Mr. Stanley's observatory it will probably be found in general practice that a telescope is capable of doing better work when placed within a building with the roof entirely off than in one enclosed by the common revolving circular dome. In the former the air currents are more likely to be nearly uniform in temperature, while in the latter type, opposing currents of air of unequal temperature are apt to materially influence definition. It is not, I believe, an extremely high nor abnormally low temperature an observer need fear, but unsteady and constantly changing air currents, within the observatory as well as without, that are inimical to good telescopic work. Once modify or minimise these conflicting elements, maintain uniformity of temperature in the observatory, and the results of astronomical observations will probably rise 50 per cent. nearer the truth than at present.

In conclusion I have great pleasure in acknowledging the efficient aid rendered by the three gentlemen with whom I was associated in this work, and of testifying to the satisfactory degree of accuracy of the times recorded by them.

Observations of Encke's Comet made at the Royal Observatory, Greenwich.

(*Communicated by the Astronomer Royal.*)

The observations were made with the East, or Sheepshanks, Equatorial, aperture 6·7 inches, by taking transits over two cross-wires at right angles to each other, and each inclined 45° to the parallel of declination. Magnifying power, 55.

Greenwich Mean Solar Time. 1895.	d	h	m	s	Observer.	☄−✶ RA. m	s	Corr. for Refraction. s	Corr. for Parallax. s	☄−✶ N.P.D. ′	″	Corr. for Refraction. ″	Corr. for Parallax. ″	No. of Comps.	Apparent R.A. of ☄. h	m	s	Apparent N.P.D. of ☄. °	′	″	Comp. ✶
Jan.	13	5	33	2	B.	−2	10·14	−0·03	+0·35	+12	50·9	+0·4	−9·4	2	22	5	12·93	89	32	44·9	*a*
	13	5	43	29	,,	−3	15·03	+0·01	+0·37	−5	31·3	−0·2	−9·4	4	22	5	12·43	89	32	54·7	*b*
	14	6	12	21	H. F.	+3	33·65	0·00	+0·42	+1	25·7	+0·1	−9·5	8	22	3	43·23	89	54	18·1	*c*
	14	6	12	21	,,	+1	59·92	+0·01	+0·42	−2	16·1	−0·1	−9·5	8	22	3	43·17	89	54	16·0	*d*
	16	6	38	7	B.	−0	7·24	+0·04	+0·48	−7	10·0	−0·6	−9·8	1	22	0	15·89	90	42	33·8	*e*
	17	6	33	24	H.	−1	12·17	+0·09	+0·48	−14	10·9	−0·7	−10·0	3	21	58	10·97	91	10	35·7	*f*
	17	6	33	24	,,	−1	39·23	+0·01	+0·48	−1	50·6	0·0	−10·0	3		...			...		*g*
	18	5	52	40	B.	−0	23·19	−0·01	+0·45	+2	24·1	+0·2	−10·2	3	21	55	57·20	91	40	21·0	*h*
	18	5	56	43	H. F.	−0	23·65	−0·01	+0·46	+2	27·7	+0·2	−10·2	3	21	55	56·75	91	40	24·6	*h*
	18	6	21	4	A. C.	−0	26·02	−0·02	+0·49	+3	6·0	+0·4	−10·2	2	21	55	54·40	91	41	3·1	*h*
	23	5	41	49	,,	+1	3·11	+0·07	+0·52	−7	40·1	−0·6	−11·1	3	21	39	57·27	95	5	0·6	*i*
	23	5	47	39	,,	−1	58·20	0·00	+0·52	−0	24·2	0·0	−11·0	3	21	39	56·69	95	5	12·2	*k*

Notes.

The observations are corrected for refraction and parallax. In computing the latter log Δ has been taken from Dr. Backlund's ephemeris (*Ast. Nach.*, 3263), the values used being 9·8652, 9·8594, 9·8476, 9·8417, 9·8356, and 9·8068 on January 13, 14, 16, 17, 18, and 23 respectively. The observations are also corrected for the error of inclination of the wires, and for the motion of the comet. The apparent errors of Dr. Backlund's ephemeris in R.A. and N.P.D. (Tabular − Observed) are $-2^s{\cdot}91$, $+17''{\cdot}2$ from star *a*; $-3^s{\cdot}00$, $+16''{\cdot}0$ from star *b*; $-2^s{\cdot}22$, $+13''{\cdot}5$ from star *c*; $-2^s{\cdot}16$, $+15''{\cdot}6$ from star *d*; $-5^s{\cdot}00$, $+41''{\cdot}4$ from star *e*; $-3^s{\cdot}39$, $+24''{\cdot}5$ from star *f*; $-4^s{\cdot}01$, $+24''{\cdot}1$ from star *h* (B.); $-3^s{\cdot}96$, $+25''{\cdot}9$ from star *h* (H. F.); $-4^s{\cdot}05$, $+19''{\cdot}5$ from star *h* (A. C.); $-5^s{\cdot}84$, $+35''{\cdot}2$ from star *i*; $-6^s{\cdot}24$, $+35''{\cdot}8$ from star *k*.

January 13.—Cloudy; comet very bright. January 14.—Comet faint; cloudy. January 16.—Very cloudy; observation rough.
January 23.—Comet visible in fairly bright twilight.

The initials H., A. C., B., and H. F. are those of Mr. Hollis, Mr. Crommelin, Mr. Bryant, and Mr. Furner respectively.

Comparison Stars.

	Star's Name.	Assumed R.A. 1895·0. h m s	Assumed N.P.D. 1895·0. ° ′ ″	Authority.
a	Lalande, 43336	22 7 23·53	89 19 57·3	Munich, Schjellerup, and Pulkowa Catalogues.
b	W.B. XXII., 112	22 8 27·85	89 38 29·9	Göttingen and Munich Catalogues.
c	B.D. −0°, 4304	22 0 9·96	89 52 55·6	Karlsruhe and Schjellerup Catalogues.
d	W.B. XXI., 1379	22 1 43·62	89 56 35·6	Brussels, Göttingen, Munich, Pulkowa, and Radcliffe 1890 Catalogues.
e	α Aquarii	22 0 23·41	90 49 47·7	Greenwich Five-year Catalogue of Fundamental Stars, 1890.
f	32 Aquarii	21 59 23·36	91 24 50·6	Radcliffe 1860, Yarnall, Schjellerup, Glasgow 1870, Karlsruhe and Radcliffe 1890 Catalogues.
g	B.D. −1°, 4245	21 59 52·0	91 13 0·0	Bonn Observations, vol. iii.
h	W.B. XXI., 1261	21 56 20·75	91 37 59·9	Karlsruhe Catalogue.
i	W.B. XXI., 865	21 38 54·38	95 12 44·0	Yarnall, 2nd Armagh, Paris, Karlsruhe, Radcliffe 1890 and Glasgow 1890 Catalogues.
k	W.B. XXI., 938	21 41 55·17	95 5 39·1	2nd Armagh, Glasgow 1870, Karlsruhe and Radcliffe 1890 Catalogues.

Notes.

The R.A. of star *a* in Lalande is 27^s too great. Star *d* is the double star Σ 2862; the mean of the places of the components has been used. A proper motion of $+0^s{\cdot}0103$ in R.A. has been applied to star *h*, deduced from comparison with Lalande, Weisse's Bessel, and Munich Catalogues. The R.A. of star *i* in Weisse's Bessel is 1^m too small. The R.A. of star *k* in Weisse's Bessel is 50^s too small.

Royal Observatory, Greenwich:
1895 *February* 13.